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HEPATICAE OF PUERTO RICO

XI. DIPLASIOLEJEUNEA

ALEXANDER W. EVANS

(WITH PLATES 16 AND 17)

In the tenth paper of this series\* three genera of the Lejeuneae are discussed in which underleaves are entirely absent. In the genus *Diplasiolejeunea* the underleaves are duplicated; in other words an underleaf is developed for every lateral leaf, instead of for every pair of lateral leaves (PLATE 16, FIGURES 1 and 10). The only other genus in which this peculiar condition is found is *Colura*, which contains some of the most remarkable species of the Lejeuneae. To explain the doubling of the underleaves in *Colura*, Goebel† advanced the theory that the leaves are not arranged in a three-ranked spiral, as is usual in the leafy Hepaticae, but that a postical segment is cut off from the apical cell after each lateral segment. This being the case the leaves would be arranged in a zigzag, and the imaginary line connecting their successive bases would not cross the antical surface of the stem at all. The examination of growing points in *Diplasiolejeunea* brought out the fact that Goebel's explanation would apply to this genus as well as to *Colura*. It should be noted, however, that the duplication of the underleaves is not an absolutely constant feature. The base of a branch, for example (FIGURE 10), shows the ordinary spiral arrangement, and the same thing is true of an antheridial spike throughout its entire length (PLATE 17, FIGURE 2). In the

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\* Bull. Torrey Club 38: 251-286. *pl.* 11, 12. 1911.

† Organographie der Pflanzen 286 (footnote). 1898.

involucre, also, a single bracteole is present for the pair of bracts (PLATE 16, FIGURE 1), just as in other genera of the *Lejeuneae*. It is evident, therefore, that the spiral arrangement of the leaves is the primitive one and that the zigzag arrangement represents a later development.

In spite of its duplicated underleaves *Diplasiolejeunea* has many characters in common with *Cololejeunea* and *Leptocolea*, in which no underleaves whatever are developed. In fact, the authors of the Synopsis Hepaticarum included in their subsection *Duplicatae*, which is one of the groups into which they divided their § *Typicae* of the genus *Lejeunea*, two species of *Leptocolea* as well as several species of *Diplasiolejeunea*. Gottsche afterwards grouped together all the *Lejeuneae* known to him in which the underleaves were duplicated, some of which naturally belong to the genus *Colura*.<sup>\*</sup> Spruce, however, was the first to define *Diplasiolejeunea* in its present sense. He included it among the subgenera of *Lejeunea*,<sup>†</sup> but it was soon raised to generic rank by Schiffner.<sup>‡</sup>

The genus is widely distributed in tropical regions and contains about twelve species. The type species, *D. pellucida* (Meissn.) Schiffn., is abundant in America and is known also from Africa, the East Indies, and New Caledonia. Three of the other species are African, one is known from Tasmania only, and the others are American. Although the plants attain a fairly large size for members of the *Lejeuneae* they are delicate in texture and show little or no pigmentation. They grow on bark and on living leaves, and at least some of the species seem to be constant in their choice of a substratum.

The stems cling closely to the substratum and branch irregularly according to the usual *Lejeunea* or *Radula* type. The stems are at first scattered, but with the appearance of branches compact mats are gradually formed, the branches lying subparallel or diverging in a more or less radiate manner. The leaves are large and usually loosely imbricated (PLATE 16, FIGURES 1, 10, and 11). The lobes are attached by an exceedingly short and almost transverse

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<sup>\*</sup> Ann. Sci. Nat. Bot. V. 1: 164. 1864.

<sup>†</sup> Hep. Amaz. et And. 301. 1884.

<sup>‡</sup> Engler & Prantl, Nat. Pflanzenfam. 1<sup>3</sup>: 121. 1895.

line, very much as in *Cololejeunea* and its immediate allies. They spread widely from the axis and lie more or less appressed to the substratum, although in some species they are distinctly convex. They vary in outline from ovate to suborbicular, their apices are broad and rounded, their margins are entire or nearly so, and they tend to arch across the axis at the antical base. The cells of the lobes are plane or nearly so, and their walls are more or less thickened. In some species the thickening appears to be uniform, while in others trigones and intermediate thickenings are clearly visible. In all the Puerto Rico species ocelli are numerous and scattered throughout the lobe, very much as in the genus *Stictolejeunea*. They are found also in the perianths but seem to be constantly absent from the lobules and underleaves. In *D. pellucida* the lobes are often margined by a band of hyaline cells, but these have not been observed in the other species.

The lobule agrees in many respects with that of *Cololejeunea*. It is of a fairly large size, from one third to one half the length of the lobe, and is inflated throughout more or less of its extent. It broadens out abruptly from a narrow base and forms a distinctly arched keel with the lobe. The free margin is involute in its basal portion and sometimes for about half its length, the outer part being frequently appressed to the lobe. At some little distance beyond the middle the apical tooth is situated and is separated from the end of the keel by a shallow sinus. The tooth is remarkably well developed and shows considerable variation in form. It may, for example, be subulate and acuminate (FIGURES 1 and 5) or it may broaden out from a stalklike base into a t-shaped structure (FIGURES 10 and 13). The hyaline papilla is situated at the base of the tooth on the inner surface of the lobule. When the base of the tooth is three cells wide the papilla is on the median cell; when the tooth is two or four cells wide it is situated on one side of the median wall, sometimes on the distal side and sometimes on the proximal. In addition to the apical tooth the free margin bears a second tooth, proximal to the apex; this tooth is shorter than the apical tooth and also different in form. Between the proximal tooth and the base of the lobule one or more minute denticulations may be distinguished in certain species.

The underleaves are sometimes distant and sometimes overlap

more or less closely. They are deeply bifid with long and spreading divisions, which taper gradually to sharp or blunt apices (PLATE 16, FIGURE 1; PLATE 17, FIGURES 1 and 2). Sometimes the divisions spread so widely that the upper margin of the underleaf is bounded by an approximately straight line. At the base a distinct radicelliferous disc is usually developed (PLATE 16, FIGURE 6) and affords a firm anchorage to the substratum. The margin is practically entire although the cells in some species often project as indistinct crenulations.

So far as known the inflorescence is either autoicous or dioicous and seems to be fairly constant for a given species. The archegonium is sometimes borne on a leading branch (FIGURE 1) and sometimes on a very short branch, in many cases a single leaf and a single underleaf being the only appendages present except the involucre leaves and the perianth (FIGURE 2). The female flower seems to be invariably subtended by a single innovation. The bracts are much smaller than the ordinary leaves and are subequally bifid (FIGURE 7), the lobule sometimes slightly exceeding the lobe in length (PLATE 16, FIGURE 17, on left). The single bracteole is free and more or less bifid, the divisions sometimes spreading widely and sometimes being suberect or connivent (PLATE 16, FIGURES 1 and 11). The perianth is sharply five-keeled, although more or less compressed, and becomes suddenly contracted at the apex into a short beak. The surface is apparently never roughened by teeth or projecting cells even along the keels. The antheridial spikes (PLATE 17, FIGURE 2) are much as in other *Lejeuneae*. They either occupy short branches or are terminal on longer branches and rarely show signs of proliferation. The bracts, which are rarely numerous, are usually diandrous. The sporophyte is essentially the same as in *Cololejeunea* and the other genera of the *Lejeuneae*.

The only species of *Diplasiolejeunea* that has been recorded from Puerto Rico is the type species, *D. pellucida*. The material collected by the writer includes this species and also three others, one of which seems to be undescribed. In distinguishing the species the lobules, the underleaves, the inflorescence, and the perichaetial bracts yield the best differential characters. The gemmiparous branches and the gemmae, which will be described at the close of the paper, may likewise be of service.

## DIPLASIOLEJEUNEA PELLUCIDA (Meissn.) Schiffn.

*Jungermannia pellucida* Meissn.; Sprengel in Linnaeus, Syst. Veg. ed. 16. 4<sup>2</sup>: 325. 1827.

*Lejeunea ocellulata* Mont. & Nees, Ann. Sci. Nat. Bot. II. 19: 264. 1843.

*Lejeunea pellucida* Meissn. in G. L. & N. Syn. Hep. 393. 1845.

*Lejeunea albifolia* Tayl. Lond. Jour. Bot. 5: 399. 1846.

*Lejeunea* (*Diplasio-Lejeunea*) *pellucida* Spruce, Hep. Amaz. et And. 302. 1884.

*Diplasiolejeunea pellucida* Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1<sup>3</sup>: 121. 1895.

Pale green or whitish, growing scattered or in depressed mats: stems 0.07 mm. in diameter, sparingly and irregularly pinnate, the branches (except the subfloral innovations) widely spreading, similar to the stems but usually with smaller leaves: leaves loosely imbricated, the lobe obliquely to widely spreading, closely appressed to the substratum, broadly ovate, 0.85–1 mm. long, 0.7–0.85 mm. wide, antical margin rounded at the base and extending across the axis, outwardly curved to the apex, postical margin also curved, sometimes forming a vague angle at the junction with the keel, antical and apical regions often bordered by from one to four rows of hyaline cells; lobule ovate, 0.4–0.5 mm. long, 0.25–0.35 mm. wide, abruptly broadening from a narrow base, inflated throughout, keel arched, free margin more or less involute, often involving the proximal tooth, apical tooth obliquely spreading, acute, mostly three to five cells long and three or four cells wide at the base, usually tipped with a row of two or three cells, the terminal cell sometimes rounded or truncate, proximal tooth smaller than the apical tooth and usually tipped with an acute cell, hyaline papilla mostly on the distal side of the apical tooth, sinus about four cells long; cells of lobe averaging about  $12\mu$  at the margin,  $23 \times 20\mu$  in the middle, and  $35 \times 20\mu$  at the base, the walls more or less thickened but with vague trigones and occasional intermediate thickenings, hyaline marginal cells (when present) thin-walled: underleaves distant, rounded to cordate at the base, broadly cuneate, about 0.085 mm. long and 0.4 mm. wide, deeply bifid with widely spreading acuminate divisions, the apical sinus being very shallow or even obsolete, margin entire or subcrenulate from projecting cells: inflorescence dioicous: ♀ inflorescence borne either on a leading branch or on a very short branch, the innovation apparently continuing the floral axis and often bearing another inflorescence; bracts obliquely spreading, sharply complicate but

not winged along the keel, shortly bifid (about one third), the lobe oblong, rounded, entire, 0.5 mm. long and 0.15 mm. wide, lobule nearly as large as the lobe, acute to acuminate, sparingly and irregularly denticulate; bracteole ovate, 0.35 mm. long, 0.15 mm. wide, bifid almost to the base with suberect or often connivent or overlapping acuminate divisions and a narrow sinus; perianth obovate, 0.95 mm. long, 0.5 mm. wide, rounded at the apex and with a very short beak: ♂ inflorescence terminal on a leading branch or occupying a short branch, not proliferating; bracts imbricated, mostly in from three to ten pairs, diandrous, strongly inflated, shortly and subequally bifid with rounded divisions, the postical sometimes bluntly pointed, keel strongly arched; bracteoles similar to the underleaves but much smaller and less deeply bifid with obliquely spreading acute divisions: capsule about 0.35 mm. in diameter; spores yellowish green, minutely verruculose, about  $20\mu$  in short diameter; elaters about  $12\mu$  wide, the wall irregularly thickened. (PLATE 16, FIGURES 1-9.)

On living leaves. Puerto Rico, without definite localities, *Schwanecke, Sintenis* (27). Sprengel describes the type locality of *Jungermannia pellucida* in the following words, "ad filices Ind. Occid." The writer has not been able to study any of the original material but bases his conception of the plant upon a series of specimens determined by various authorities. The species occurs in two fairly distinct modifications, the second of which is described below as a new variety. The typical form may be recorded from the following additional localities in the American tropics: Cuba, *Wright*; Jamaica, *Underwood, C. E. Cummings, N. L. Britton, Evans*; Costa Rica, *Pittier*; French Guiana, *Leprieur, Perrottet*; Brazil, *Endlicher, Pabst, Spruce, Glaziou*. Material from the various collections mentioned, much of which is in the British Museum, has been examined by the writer. The specimen collected by Leprieur, however, which represents the type of *Lejeunea ocellulata*, is in the Montagne herbarium at Paris. Of African specimens two have been studied, one collected in 1814 by Beauvais at "Oware," and the other by Rodriguez on the island of Mauritius. Both agree with the American plant, so far as can be determined by the fragmentary material. The Beauvais specimens, one of which is in the Kew herbarium, represent the type of *L. albifolia*, and show a certain approach to the variety described below. As has already been noted, *D. pellucida* has been reported

also from the East Indies and from New Caledonia, but no material from these regions has been available for study.

***Diplasiolejeunea pellucida malleiformis* var. nov.**

Apical tooth of lobule variable, sometimes as in the typical form of the species but usually t-shaped, the terminal portion consisting of from two to four cells placed at right angles to a short stalk, the latter one cell or rarely two cells wide: in other respects agreeing closely with the type. (TEXT FIGURE 1.)

On leaves, rarely on bark. El Yunque, *Evans* (10, 120 in part, 127 in part). The variety may also be recorded from the following stations: John Crow Peak, Jamaica, *Evans* (135 in part); Grande Soufrière Hill, Dominica, *Elliott* (1815, 1816); Laudat, Dominica, *Lloyd* (324a in part); St. Vincent, *Elliott* (9, 22, 356).

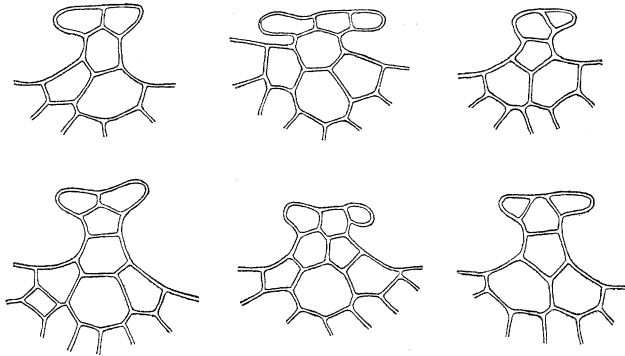


FIGURE 1. *Diplasiolejeunea pellucida malleiformis*; El Yunque, Puerto Rico, *Evans* (10). Apical teeth of lobules,  $\times 300$ .

The t-shaped apical tooth of the lobule in this curious variety is so different from the pointed tooth in typical *D. pellucida* that a specific separation seemed at first to be indicated. Unfortunately further study soon showed that this single difference was quite unsupported by others, and also that the t-shaped tooth formed an inconstant feature, some of the specimens showing both t-shaped and ordinary pointed teeth. In the Beauvais specimens noted above, none of the teeth are distinctly t-shaped, although some are tipped by two cells placed side by side at right angles to the stalk, and the latter is occasionally two cells wide. The material from the Grande Soufrière, Dominica, is in the herbarium of the



British Museum and was referred by Stephani to his *D. armatiloba*,\* a species that requires further study. It was based on sterile specimens from Guadeloupe and was regarded by Gottsche as a variety of *D. pellucida*. Unfortunately the type has not been accessible, but a specimen in the British Museum, collected by Elliott at Trois Pitons, Dominica (1754), and determined by Stephani, coincides closely with the original description. This plant has a dioicous inflorescence and is very much like the variety *malleiformis*, the apical tooth of the lobule being even more definitely t-shaped. The underleaves, however, have rounded or obtuse divisions, which spread obliquely.

***Diplasiolejeunea brachyclada* sp. nov.**

Pale green or yellowish, scattered or in depressed mats: stems 0.1 mm. in diameter, sparingly and irregularly pinnate, the branches widely spreading, similar to the stem: leaves loosely imbricated, the lobe obliquely to widely spreading, not appressed to the substratum, plane or more or less squarrose in the antical portion, broadly ovate, 1.25–1.5 mm. long, 1–1.1 mm. wide, when well developed, antical margin rounded at the base and extending across the axis, outwardly curved to the apex, postical margin straight or slightly curved, forming a very obtuse angle at the junction with the keel; lobule ovate, 0.7 mm. long, 0.3 mm. wide, inflated throughout, keel arched, free margin involute at least near the base, apical tooth obliquely spreading, acute, truncate or t-shaped, mostly three or four cells long and two cells wide at the base, proximal tooth sometimes inflexed, shorter than the apical tooth and acute, hyaline papilla distal in position; cells of lobe averaging about  $12\mu$  at the margin,  $27 \times 18\mu$  in the middle, and  $38 \times 20\mu$  at the base, the walls thickened uniformly: underleaves distant, rounded to subcordate at the base, broadly cuneate, averaging about 0.17 mm. in length and 0.6 mm. in width, deeply bifid with obliquely spreading acute divisions and a very obtuse sinus, margin entire: inflorescence autoicous: ♀ inflorescence borne on a very short branch, a single leaf and a single underleaf being present in addition to the involucre leaves and perianth, the innovation usually simple and sterile, rarely bearing a second female flower; bracts obliquely spreading, sharply complicate but not winged along the keel, bifid about one fourth, the lobule often a little longer than the lobe, the latter oblong, 0.5 mm. long, 0.17 mm. wide, rounded at the apex, entire or vaguely and sparingly

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\* Hedwigia 35: 80. 1896.

denticulate along the margin, lobule obtuse, sparingly denticulate; bracteole oblong-obovate, 0.5 mm. long, 0.3 mm. wide, bifid about one half with acute suberect divisions, entire or irregularly crenulate from projecting cells; perianth oblong or oblong-ovate, 1.2 mm. long, 0.5 mm. wide, rounded to truncate at the apex and with a very short beak: ♂ inflorescence occupying a short branch, very rarely proliferating; bracts imbricated, in from two to four pairs, similar to those of *D. pellucida*; bracteoles also similar: mature sporophyte not seen. (PLATE 16, FIGURES 10-18.)

On bark of trees. Puerto Rico: El Yunque, *Evans* (24, 127 in part). Jamaica: Cinchona, *Evans* (138, 250 in part). No. 24 may be designated the type.

This new species is closely related to *D. pellucida* but is at once distinguished by its larger size and by its autoicous inflorescence. The leaves, furthermore, always lack the hyaline border, which is so frequent in *D. pellucida*, and are never closely appressed to the substratum; in fact, they are oftentimes distinctly squarrose in the antical region. In other respects they are much alike in the two species. The underleaves yield a few additional points of distinction. In *D. pellucida* the divisions are acuminate and spread so widely that the upper margin of the underleaf is often scarcely indented in the middle. In *D. brachyclada* the divisions spread obliquely and form a distinct angle where they come together. Their apices are acute, rather than acuminate, and are usually tipped with a single cell; even when tipped with two superimposed cells they taper more abruptly than in *D. pellucida*. Apparently the female inflorescence in *D. brachyclada* is invariably borne on an abbreviated branch, but the involucreal leaves and perianths show no very striking peculiarities. The antheridial spikes, also, show little tendency to vary in length. In *D. pellucida* both male and female branches are subject to marked variation in this respect.

DIPLASIOLEJEUNEA UNIDENTATA (Lehm. & Lindenb.) Schiffn.  
*Jungermannia unidentata* Lehm. & Lindenb. in Lehmann, Pug.  
Plant. 6: 48. 1834.  
*Lejeunea unidentata* Lehm. & Lindenb. in G. L. & N. Syn. Hep.  
392. 1845.  
*Lejeunea (Diplasio-Lejeunea) unidentata* Steph. Hedwigia 29: 90.  
1890.

*Diplasiolejeunea unidentata* Schiffn. Bot. Jahrb. 23: 583. 1897.

Pale green or whitish, growing in compact depressed tufts: stems 0.14 mm. in diameter, prostrate, irregularly pinnate, the branches obliquely to widely spreading, similar to the stem but usually with smaller leaves: leaves imbricated, the lobe widely spreading, somewhat convex, broadly ovate to suborbicular, 1.2–1.4 mm. long, 1–1.2 mm. wide, antical margin straight to rounded at the base, usually arching across the axis, strongly outwardly curved to the apex, postical margin also curved, forming a very obtuse or rounded indentation at the junction with the keel; lobule obovate, 0.7 mm. long, 0.4 mm. wide, inflated along the arched keel, more or less appressed to the lobe in the outer portion, free margin involute near the base but usually plane otherwise, apical tooth acute, obliquely spreading, mostly three to five cells long and two or three cells wide at the base, usually tipped with two superimposed cells, proximal tooth much shorter and often inconspicuous, acute to rounded, hyaline papilla mostly distal, sinus shallow, forming a distinct angle with the apical tooth; cells of lobe averaging  $18\mu$  at the margin,  $28 \times 18\mu$  in the middle and  $32 \times 18\mu$  at the base, more or less thickened and usually with distinct trigones and occasional intermediate thickenings: underleaves distant to subimbricated, broadly cuneate, 0.2 mm. long in the middle, 0.5–0.6 mm. wide, bifid about one half with obliquely spreading divisions, obtuse to rounded at the apex, sinus mostly acute, margin entire: inflorescence dioicous: ♀ inflorescence borne on a leading branch or on a more or less abbreviated branch, the innovation mostly simple and sterile; bracts obliquely spreading, sharply complicate and sometimes very narrowly winged along the keel, bifid one third to one half, the lobe oblong, 0.6 mm. long, 0.25 mm. wide, rounded at the apex, entire, lobule similar in form, 0.5 mm. long, 0.22 mm. wide, rounded to very obtuse at the apex, margin entire; bracteole ovate, 0.45 mm. long, 0.35 mm. wide, bifid about one third with acute suberect divisions and an entire margin; perianth as in *D. pellucida*, 1.3 mm. long, 0.75 mm. wide: ♂ inflorescence occupying a short branch, not proliferating; bracts mostly in from three to six pairs, similar to those of *D. pellucida*; bracteoles also similar: mature sporophyte not seen. (PLATE 17, FIGURES 1–12.)

On bark, rarely on leaves. El Yunque, *Evans* (2, 120 in part, 145). The species is known to the writer from the following additional localities: Mansfield, Jamaica, *Evans* (336); Sharford Estate, Dominica, *Elliott* (1601); Martinique, *Duss*; St. Vincent, Herb. Hooker, the type station.

The present species and the following, *D. Rudolphiana*, have been so much confused that a brief account of their history may not be out of place. *Jungermannia unidentata* was originally described from a specimen in the Hooker herbarium, collected on the island of St. Vincent. A portion of this original material is preserved at Kew, and although it is perfectly sterile it agrees so closely with the other plants cited above that there can be but little doubt that they represent the same species. A similar specimen from the Lehmann herbarium is in the Montagne herbarium at Paris. In 1845 Montagne reported *D. unidentata* from Cuba, his record being based on specimens collected by Ramon de la Sagra.\* He also published figures of these specimens, and since his time *D. unidentata* has been listed from a number of localities in tropical and subtropical America, many of the determinations being apparently based on these figures. A careful study of Montagne's specimens, however, has shown that the Cuban plant is not the same as the type specimen in the Hooker herbarium, and that some of the published records for the species are therefore incorrect, a fact which the writer has already noted elsewhere.† The Cuban plant, however, does not represent an undescribed species. It agrees closely with *D. Rudolphiana*, and the same thing is true of some of the other specimens that have been referred to *D. unidentata*.

In the opinion of Spruce,‡ *D. unidentata* ought to be considered as a variety of *D. pellucida*, but there are many reasons for regarding them as distinct species, in spite of the fact that both are dioicous. *D. unidentata* is a more robust plant than *D. pellucida*, it grows normally on bark and not on leaves, it is much less closely appressed to the substratum, its leaves always lack hyaline borders, and the leaf cells usually show distinct local thickenings in their walls. The underleaves, too, present a very different appearance. The divisions spread obliquely, forming a distinct sinus, and their apices vary from obtuse to rounded instead of being acuminate. In the involucre the bracteole is much less deeply bifid than in *D. pellucida*, and the lobes are consequently broader

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\* In Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba 9: 478. pl. 19. f. 2. 1845.

† Bull. Torrey Club 38: 207. 1911.

‡ Hep. Amaz. et And. 302. 1884.

and less sharply pointed; the perianth, however, is essentially the same. When compared with *D. brachyclada*, the dioicous inflorescence, the absence of t-shaped apical teeth on the lobules, the distinct local thickenings in the cell walls, and the blunter divisions of the underleaves will serve as distinguishing characteristics.

DIPLASIOLEJEUNEA RUDOLPHIANA Steph.

*Lejeunea unidentata* Mont. in Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba 9: 478. pl. 19. f. 2. 1845. Not Lehm. & Lindenb.  
*Diplasiolejeunea Rudolphiana* Steph. Hedwigia 35: 79. 1896.

Yellowish or brownish green, growing in compact depressed tufts: stems 0.12 mm. in diameter, sparingly and irregularly pinnate, the branches widely spreading, similar to the stem but usually with smaller leaves: leaves imbricated, more or less convex, the lobe widely spreading, broadly ovate, 1.2–1.4 mm. long, 1–1.2 mm. wide, antical margin rounded at the base, arching across the axis, strongly outwardly curved to the apex, postical margin likewise curved, forming a rounded indentation at the junction with the keel, margin entire or vaguely and sparingly crenulate from projecting cells; lobule obovate, 0.7 mm. long, 0.35 mm. wide, inflated in carinal region or throughout, keel arched, free margin involute near the base but usually plane elsewhere, apical tooth long and slender, subparallel with the axis or obliquely spreading, usually from six to eleven cells long and two cells wide at the base, proximal tooth shorter but sharp and distinct, often inflexed, usually tipped with a row of two or three cells, hyaline papilla distal; cells of lobe averaging  $15\mu$  at the margin,  $28 \times 22\mu$  in the middle, and  $37 \times 25\mu$  at the base, walls slightly thickened showing small trigones and very rare intermediate thickenings: underleaves distant to subimbricated, broadly cuneate, 0.17–0.2 mm. long in the middle, 0.4–0.6 mm. wide, bifid about one half with a rounded sinus and obliquely spreading divisions, mostly rounded at the apex but occasionally obtuse or subacute, margin as in the leaves: inflorescence autoicous: ♀ inflorescence borne on an elongated branch or on a very short branch, the innovation usually simple and sterile; bracts obliquely spreading, strongly complicate and very narrowly winged along the keel, bifid two thirds to three fourths, the lobe oblong-obovate, 0.4 mm. long, 0.17 mm. wide, rounded, margin vaguely crenulate from projecting cells, lobule oblong, 0.35 mm. long, 0.12 mm. wide, obtuse to subacute, margin as in the lobe; bracteole ovate, 0.35 mm. long, 0.25 mm. wide, bifid one fifth to one third with acute

to obtuse suberect divisions, margin as in the bracts; perianth much as in *D. pellucida*, 1.3 mm. long, 0.5 mm. wide: ♂ inflorescence occupying a short branch, not proliferating; bracts mostly in from three to six pairs, similar to those of *D. pellucida*; bracteoles also similar: mature sporophyte not seen. (PLATE 17, FIGURES 13-17.)

On bark of trees. Near Cayey, 1900, *Evans* (96 in part, 102). The writer has examined specimens from the following additional localities: near Camp Longview, Florida, *Small & Wilson* (mixed with 2058); various stations on New Providence, Bahama Islands, *Coker, E. G. Britton*,\* Cuba, *Ramon de la Sagra, Wright*; near Port Margot, Hayti, *Nash* (165); Troy, Jamaica, *Evans* (658); Paramaribo, Dutch Guiana, *Kegel*; Petropolis, Brazil, *Rudolph*, the type locality. The portion of the type that was studied is in the herbarium of the British Museum and agrees closely with the other specimens cited.

Although the geographical distribution of *D. Rudolphiana* is by no means thoroughly known, it seems to be the dominant representative of the genus in the lowlands of tropical America. It is often associated with the presence of man and occasionally occurs at higher altitudes along roadsides and in plantations. In this respect it resembles the common *Frullania squarrosa* (R., Bl. & N.) Dumort. It is closely related to *D. unidentata* but differs from it in two important particulars, its autoicous inflorescence and the remarkable development of the apical teeth of its lobules. The teeth form a very characteristic feature of the plant, even if poorly developed branches sometimes fail to show them in a typical condition. When well developed the apical tooth attains a length of about ten cells and is two cells wide for at least half its extent. It occupies a position parallel with the axis, and this is due, sometimes at least, to a curve at the base. The portion of the lobule from which the tooth arises shows an almost straight edge, the tooth forming a distinct angle on each side. The base is usually four cells across and the hyaline papilla is borne on the outer of the two median cells. The proximal tooth, also, is unusually long and distinct but is sometimes strongly inflexed and difficult to demonstrate. Between the proximal tooth and the

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\* Bull. Torrey Club 38: 207. 1911.

base one or two minute teeth, each consisting of a single projecting cell, can sometimes be distinguished. In cases where the apical tooth spreads obliquely, as in *D. unidentata*, it shows the same complexity as when parallel with the axis. Aside from the peculiarities just noted *D. Rudolphiana* is much like *D. unidentata*, and almost the same differential characters will serve to separate it from *D. pellucida* and *D. brachyclada*.

#### VEGETATIVE REPRODUCTION IN DIPLASIOLEJEUNEA

The vegetative reproduction in *Diplasiolejeunea* is carried on by means of discoid gemmae, which bear a marked resemblance to those found in the genera *Cololejeunea*, *Leptocolea*, and *Aphanolejeunea*. These gemmae have been demonstrated in *D. pellucida* (including the variety *malleiformis*), in *D. unidentata*, and in *D. Rudolphiana*. They have not yet been observed in *D. brachyclada*, however, and it is therefore possible that they are associated with certain species and never produced by others.

In *D. pellucida* the gemmae are borne on the lower surface of ordinary leaf lobes (TEXT FIGURE 2, A) and seem to be entirely absent from bracts and perianths. They occur on plants of either sex but tend to be more frequent on male individuals. In some cases the leaves on one side of a gemmiparous axis will develop gemmae much more abundantly than the leaves on the other side. Apparently the production of gemmae has no marked effect on the growth of the shoot, and the leaves upon which the gemmae are borne show no modifications. In *D. unidentata* and *D. Rudolphiana* the gemmiparous branches are very different from those of *D. pellucida* and much more highly specialized. They show a definite limitation in growth, and the gemmae are restricted to the youngest leaves that reach maturity, in most cases to the terminal pair of leaves (PLATE 17, FIGURES 1 and 3). These leaves differ considerably from normal leaves. Instead of being plane or convex, when examined from above, they are distinctly concave in the apical portion; and instead of spreading widely from the axis they spread very slightly. They are also relatively narrower than normal leaves, although sometimes larger. The modifications in the lobule affect chiefly the apical tooth, which is distinctly shorter than on normal leaves (FIGURE 6) and tends to be

nearer the outer extremity of the free margin. The hyaline papilla occupies the usual position but no proximal tooth is developed. The gemmae, which are produced in great abundance, are confined to the apical portion of the lobe, but are situated on the lower surface as in *D. pellucida*.

The development of the gemmae is essentially the same as in *Cololejeunea* and its allies, so that only the most important features of the process need be mentioned. The establishment of the mother cell of the gemma, the division into quadrants, and the greater growth of the apical quadrants take place as described by Stevens for *Cololejeunea Biddlecomiae* (Aust.) Evans.\* In the same way each apical quadrant proceeds to divide as a two-sided apical cell and cuts off two series of segments, the first division wall being parallel with the median wall of the gemma. The segmentation, however, is carried considerably further, the number of segments being usually from seven to ten. It will be remembered that five is the highest number of segments observed in *Leptocolea*. The gemma shown in TEXT FIGURE 2, *B* has ten

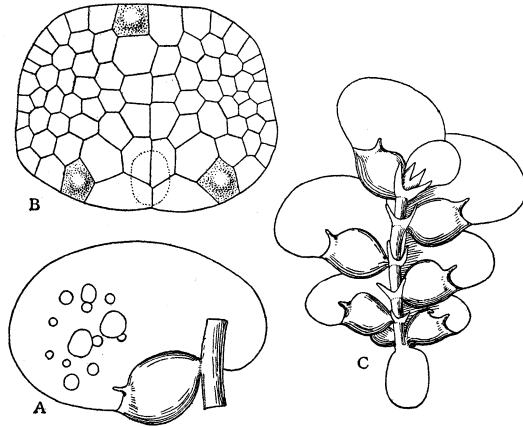


FIGURE 2. *Diplasiolejeunea pellucida*; Morce's Gap, Jamaica, Evans (55).  
A. Gemmiparous leaf, postal view,  $\times 40$ . B. Gemma,  $\times 300$ . C. Germinating gemma, postal view,  $\times 40$ .

segments on the left-hand side and nine on the right-hand side. The subsequent divisions in the segments are largely by periclinal walls, as many as three such walls appearing in some of the older

\* Bull. Torrey Club 37: 366-369. f. 1. 1910.

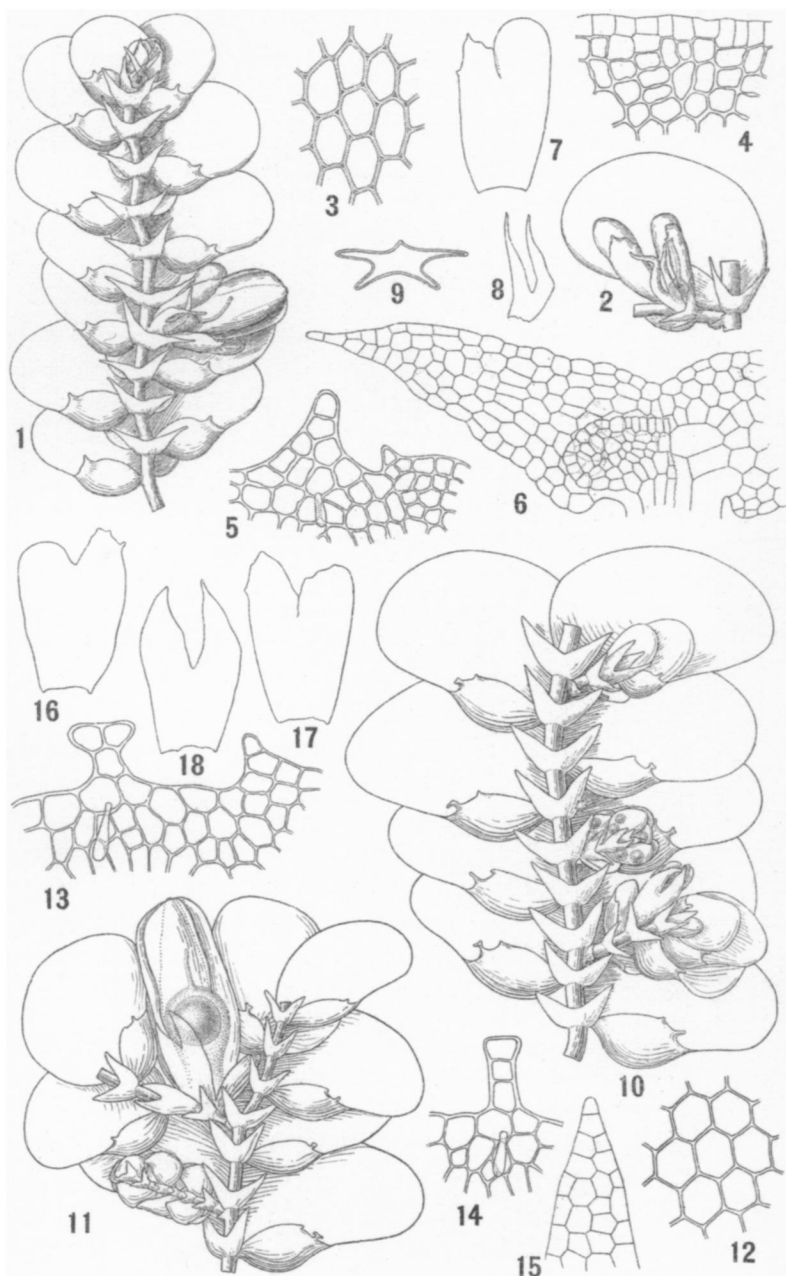


segments. In the younger segments, however, there is often an anticlinal wall formed in the most external cell. So far as observed the basal quadrants always divide by a single periclinal wall. The attachment of the gemma is markedly excentric, and the separation takes place just as in *Cololejeunea*, a slightly projecting stalk cell being left behind.

The curious organs of attachment, noted in the genera *Cololejeunea*, *Leptocolea*, and *Aphanolejeunea*, are developed also in the gemmae of *Diplasiolejeunea*. In the vast majority of cases there are three such organs on each gemma. One arises from the outermost cell of one of the oldest segments on one side of the median wall, while the other two arise from the outermost cells of the second segments cut off from the apical quadrants. In a single instance a gemma with four organs of attachment was observed, one arising in each of the oldest segments. It will be noted that in contrast to *Cololejeunea* and its allies the basal quadrants play no part in the development of the organs of attachment. The mature gemma consists of an oval plate of cells broader than long. The margin is entire, and the apical cell in each half is clearly visible, being sometimes situated in a slight depression. The gemmae in *D. pellucida*, *D. unidentata*, and *D. Rudolphiana* are essentially alike.

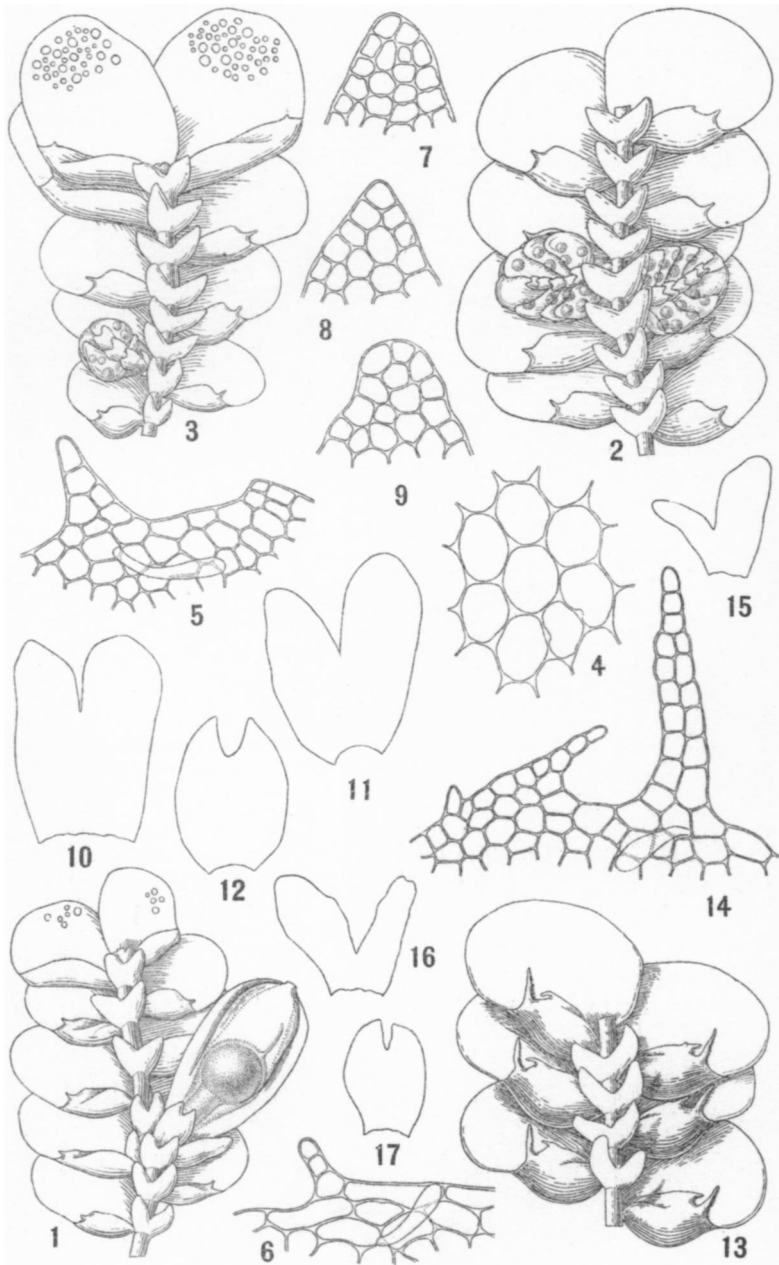
The germination follows the same course as in *Cololejeunea*, one of the apical cells of the gemma functioning directly as the apical cell of the leafy shoot without the interpolation of a thalloid structure (TEXT FIGURE 2, C). The leaves at the base of the shoot are rudimentary and have no corresponding underleaves, but the characteristic features of the genus are very quickly acquired. In one case both apical cells had given rise to shoots, but one was much better developed than the other.

YALE UNIVERSITY.



1-9 *DIPLASIOLEJEUNEA PELLUCIDA* (Meissn.) Schiffn.

10-18 *DIPLASIOLEJEUNEA BRACHYCLADA* Evans



1-12 *DIPLASIOLEJEUNEA UNIDENTATA* (Lehm. & Lindenb.) Schiffn.

13-17 *DIPLASIOLEJEUNEA RUDOLPHIANA* Steph

**Explanation of plates 16 and 17**

The figures were drawn by the writer and prepared for publication by Mr. Stanley C. Ball.

## PLATE 16

*Diplasiolejeunea pellucida* (Meissn.) Schiffn. 1. Part of a plant, showing a perianth borne on a leading branch, postical view,  $\times 25$ . 2. A short branch bearing a female inflorescence, postical view,  $\times 35$ . 3. Cells from middle of lobe, the dotted line representing the thickness of the wall about halfway between the two leaf surfaces,  $\times 265$ . 4. Cells from margin of lobe,  $\times 265$ . 5. Apex of lobule,  $\times 200$ . 6. Part of an underleaf,  $\times 200$ . 7, 8. Bract and bracteole from a single involucre,  $\times 45$ . 9. Transverse section of a perianth above the middle,  $\times 35$ . The figures were all drawn from specimens collected by the writer at Morce's Gap, Jamaica (55).

*Diplasiolejeunea brachyclada* Evans. 10. Part of a plant showing two female inflorescences and a male spike, postical view,  $\times 25$ . 11. Part of a plant with a perianth and an antheridial spike, postical view,  $\times 25$ . 12. Cells from middle of lobe,  $\times 265$ . 13. Apical portion of a lobule,  $\times 200$ . 14. Apical tooth of another lobule,  $\times 200$ . 15. Apex of an underleaf division,  $\times 200$ . 16-18. Bracts and bracteole from a single involucre,  $\times 45$ . The figures were all drawn from specimens collected by the writer, FIG. 11 being from the type specimen (24), and the others from no. 127.

## PLATE 17

*Diplasiolejeunea unidentata* (Lehm. & Lindenb.) Schiffn. 1. Female branch with perianth and innovation, the latter gemmiparous, postical view,  $\times 25$ . 2. Part of a plant with two antheridial spikes, postical view,  $\times 25$ . 3. Apical portion of a gemmiparous branch, postical view,  $\times 25$ . 4. Cells from middle of lobe,  $\times 265$ . 5. Apical portion of a lobule,  $\times 200$ . 6. Apical portion of the lobule of a gemmiparous leaf,  $\times 200$ . 7-9. Apices of underleaf divisions,  $\times 200$ . 10-12. Bracts and bracteole from a single involucre,  $\times 45$ . The figures were all drawn from specimens collected by the writer, FIG. 1, 10, 11, and 12 being from no. 2, and the others from no. 145.

*Diplasiolejeunea Rudolphiana* Steph. 13. Part of a leading axis, postical view,  $\times 25$ . 14. Apical region of a lobule,  $\times 200$ . 15-17. Bracts and bracteole from a single involucre,  $\times 45$ . The figures were all drawn from specimens collected by G. V. Nash near Port Margot, Hayti (165).